United States Utility Patent Application

Vacuum Packaging System

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Cross Reference to Related Applications

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Vacuum Packaging System

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This invention relates to a vacuum packaging system that may be used to conveniently store foods and other perishable items. A hand-held appliance is upwardly compatible with a front loading appliance, and performance may be enhanced with an innovative two stage vacuum system. Uniquely designed vacuum bags allow the free flow of air past objects contained therein, allowing the system to achieve levels of vacuum suitable for food storage purposes. A passive indicator assures consumers that a safe level of vacuum has been reached and maintained.

Background

The demand for vacuum packaging systems has increased in recent years as consumers become more aware of their suitability for storing food and other perishable items. Many consumers are now buying bulk packaged foods that may be sub-divided into smaller portions, and they are becoming more aware of conserving leftovers rather than treating them as waste. Further, consumers are experimenting with new ways to use vacuum packaging systems such as for marinating meats.

Existing vacuum packaging systems typically use heat sealable bags. The process is relatively simple – draw a vacuum within the bag, and then apply a heat seal on the end of the bag. Less expensive bags, such as those available from Philips, do not allow a sufficient vacuum to be drawn since the bags tend to "cling" to the irregular surfaces of the objects within the bags, preventing the free flow of air past these objects and thus preventing all of the air from being withdrawn from the bag. Other more expensive bags, such as those available from Tilia, contain a series of protrusions on at least one inside surface to hold the bag away from the objects within the bag, thus allowing air to be

pumped from the extremities of the bag that extend beyond these objects. While these bags may work well, they are expensive to produce and they have a substantially higher retail price than the "standard" storage bags described above. Lacking is a cost effective vacuum storage bag that offers good performance.

Further, existing vacuum packaging systems typically use a tabletop unit having a horizontal orientation and a top loading vacuum chamber. While this configuration works, it does have the disadvantage of drawing fluids into the vacuum chamber along with the air being pumped from the bag, driving the requirement for a fluid trap. Further, the existing units are large and usually stored "out of sight" because of their bulk. Apart from being inconvenient for the consumer, this is also a disadvantage to the manufacturer since "out of sight, out of mind" consumer behaviour means that the unit will not be used as often and as a result, the consumers will buy fewer bags. Lacking are systems attractively designed to remain in sight and handy for use, as well as systems designed to prevent the drawing in of fluids when in use.

Operationally, common complaints associated with most systems include the difficulty of operation, requiring two hands, and the time taken to draw an acceptable vacuum and heat seal the bag. In contrast, ease of use, automatic operation, and faster performance are features that would create differentiation and increase demand for one manufacturer's product over another.

These observations may be validated by reviewing the related existing art which includes US Patent 6,256,968 issued 7/10, 2001 to Kristen (assigned to Tilia International, HK), US patent 6,185,796 issued 2/13, 2001 to Ausnit (assigned to Illinois Tool Works, Inc.), US Patent 6,058,998 issued 5/9, 2000 to Kristen (assigned to Tilia International, HK), US Patent 6,000,198 issued 12/14, 1999 to Tramposch (assigned to Calgon Carbon Corporation), US Patent 5,894,929 issued 4/20, 1999 to Kai, et al (assigned to Yugenkaisho Kusaka Raremetal Kenkyusho, Japan), US Patent 5,822,956 issued 10/20, 1998 to Liechti, et al (assigned to Inauen Maschinen AG), US Patent 5,765,608 issued 6/16, 1998 to Kristen (assigned to Tilia International, Hong Kong), US Patent 5,655,357 issued 8/12, 1997 to Kristen (assigned to Tilia International, HK), US Patent 5,638,664 issued 6/17, 1997 to Levsen, et al, (assigned to Hantover Inc.), US Patent Re. 34,929 issued 5/9, 1995 to Kristen (assigned to Tilia, Inc.), US Patent

5,364,241 issued 11/15, 1994 to Schultz (Assigned to Pioneering Concepts, Inc.), US Patent 5,338,166 issued 8/16, 1994 to Schultz (assigned to Pioneering Concepts, Inc.) US Patent 5,299,917 issued 4/5, 1994 to Schultz (assigned to Pioneering Concepts, Inc.), and US Patent 4,941,310 issued 7/17, 1990 to Kristen (assigned to Tilia Aktiengesellschaft).

Of these, US 6,185,796 assigned to Illinois Tool Works, US 6,000,198 assigned to Calgon Carbon Corporation, US 5,894,929 assigned to Yugenkaisho Kusaka Raremetal Kenkyusho, and US Re. 34,929 teach various ways to produce vacuum bags. US '796 teaches a reclosable zipper having interlocking members which engage and interlock to form a vacuum seal. US '198 teaches the inclusion of an absorbent material, at an elevated temperature, with the object to be vacuum stored such that the subsequent cooling of the absorbent material will create a vacuum. US '929 teaches a sterilizing and vacuum packaging bag having a partially fused partition that may be ruptured through microwave heating of the contents. US Re.'929 teaches a multi-layer vacuum packaging bag, at least one inner surface having a plurality of raised protuberances with uniform thickness and formed in a generally regular and waffle-like pattern projecting outwardly there from towards the inner surface of the other panel to define a plurality of intercommunicating channels entirely around and between the protuberances.

Another group, US 5,822,956 assigned to Inauen Maschinen, US 5,765,608 assigned to Tilia, US 5,638,664 to assigned Hantover, US 5,364,241, US 5,338,166, and US 5,299,917 assigned to Pioneering Concepts, and US 4,941,310 assigned to Tilia all disclose various vacuum packaging appliances. US '956 teaches a commercial device having a cover mounted on articulated arms for control and clamping purposes. US '608 teaches a motorized hand-held device specifically suited for vacuum storage canisters with the correct pump / canister interface. US ' 664 teaches an apparatus having a moveable sealing element which may be pressed against vacuum storage bag for sealing purposes. US '241, 166, and '917 all teach various hand-held devices having a manual pump and designed to interface with a variety of types and sizes of containers. Finally, US ' 310 teaches a top loading apparatus suited for sealing bags not larger than the vacuum chamber, having a single stage evacuation pump, manually applied sealing clamps, a trough for ingested fluids, and an attachment area for an external vacuum hose.

A final group, US 6,256,968 assigned to Tilia, US 6,058,998 assigned to Tilia, and US 5,655,357 assigned to Tilia teach various ways to resolve issues particular to current vacuum storage systems. US '968 teaches a volumetric control system that monitors system performance between two preset vacuum levels to calculate an altitude sensitive time to completion for the air evacuation process. US '998 teaches a capacitor discharge system that may be used in conjunction with a relatively small source of power to provide power for the heat sealing element. Finally US '357 teaches an exhaust flow rate sensor that converts exhaust pulses to a signal that may be used to deduce the progress of the vacuum process.

Summary of the Invention

The vacuum packaging system as taught by the present invention includes heat sealable bags specifically designed for vacuum storage, a process for inexpensively manufacturing the same, a hand-held vacuum storage appliance that is adapted for portable use, and a front loading vacuum storage appliance that may be adapted to fit neatly under cupboards and remain accessible at all times, a two stage vacuum pumping system for enhanced performance, and a passive vacuum indicator for consumer use.

The vacuum storage bags contain a series of intersecting air channels on the inside surfaces, designed to allow the free flow of air past objects contained therein and thus allowing a maximum amount of air to be withdrawn from the bag. The intersecting air channels may be formed during the manufacturing process by first forming a series of obliquely oriented channels in a plastic sheet. The plastic sheet may be formed into a vacuum storage bag by folding one half over the other such that the obliquely oriented channels intersect to form a regular diamond pattern on the inside surfaces of the bag. Then, one or two of the non-folded sides of the product may be heat sealed, forming a roll or a bag respectively.

The hand-held vacuum storage appliance is an entry level product that may be used with smaller "Ziploc" sized bags. The appliance is further adapted for use with larger bags by incorporating a unique "L" shaped sealing bar that allows the appliance to seal the larger

bag in two stages without requiring any precise alignment. The final seal profile, although not a straight line, does form a continuous seal across the end of the bag. The hand-held device may be easily positioned above the bag during the sealing process to substantially prevent the drawing in of fluids during the sealing process.

The front loading vacuum storage appliance may be adapted to mount conveniently under the overhead cupboards in a kitchen. A work platform extends from the base of the unit and automatically dispenses, with each use, a new section of vacuum storage bag from a roll located at the back of the unit. The bag may be sealed on one end, and then vacuum sealed and date stamped, by simply pressing a button and then positioning the bag correctly within the appliance. The front loading mechanism substantially prevents the drawing in of fluids while creating a vacuum within the bag. Finally, a retractable vacuum hose and a vacuum docking station under the appliance facilitate the vacuum sealing of wine bottles, canisters, spice bottles, and the like.

A two stage vacuum pumping system speeds the vacuum storage process by deploying a first pump or source of vacuum to quickly draw a low level of vacuum, and then a second pump to complete the process by drawing a higher level of vacuum suitable for food storage purposes. Both may be deployed during the initial stage to increase the airflow. Further, the first pump or source of vacuum may be an internal vacuum retention area that may be "charged" by using the second pump to draw a vacuum in this area while the appliance is not in use.

A passive vacuum sensor may be used by the consumer to indicate that a suitable level of vacuum exists within the vacuum storage bag, bottle, canister, or any other type of vacuum storage container with a visible interior. The passive vacuum sensor uses a vacuum sensitive bladder that expands under a vacuum, this providing a visible indicator of vacuum.

Embodiments

Embodiments of the invention are described by way of example with reference to the drawings in which:

Figure 1 illustrates a formed plastic sheet prior to forming a roll or bag,

Figure 2 provides a sectional view of a formed plastic sheet and illustrates a process for forming the oblique channels,

Figure 3 illustrates folding of a formed plastic sheet,

Figure 4 provides a sectional view of a folded plastic sheet,

Figure 5 provides an alternative sectional view of a folded plastic sheet,

Figure 6 illustrates a vacuum bag in roll format,

Figure 7 illustrates a vacuum bag in bag format,

Figure 8 provides a side view of the hand-held vacuum storage appliance,

Figure 9 provides an internal view of the hand-held vacuum storage appliance,

Figure 10 provides further detail regarding the heat sealing strip,

Figure 11 illustrates a two step process for sealing a larger vacuum storage bag,

Figure 12 illustrates the effectiveness of an "L" shaped sealing pattern under several misalignment scenarios,

Figure 13 provides a top view of hand-held vacuum storage appliance and illustrates the operation thereof,

Figure 14 provides a side view of the front loading vacuum storage appliance,

Figure 15 illustrates the auto bag sensing and pull-in mechanisms,

Figure 16 illustrates how the pull-in pins interface with the front cover,

Figures 17a and 17b illustrate how the pull-in pins may be releasably attached to the front cover,

Figure 18 provides a side view of the front loading vacuum storage appliance with a work platform,

Figure 19 shows the work platform in the extended position,

Figure 20 provides a front perspective view of the front loading vacuum storage appliance illustrates several operational features,

Figure 21 illustrates the two stage vacuum pumping system,

Figure 22 illustrates an alternative system using only one pump and a vacuum retaining chamber,

Figure 23 illustrates a passive vacuum indicator,

Figures 24a and 24b illustrate a vacuum clip in the open and closed positions, respectively,

Figure 25 provides a front view of the vacuum clip components associated with the main body of the front loading vacuum storage appliance,

Figure 26 illustrates a vacuum clip with active seals on the sides,
FIG. 27 illustrates an alternative vacuum clip with an inserted vacuum bar, and;
Figure 28 provides a top view of the alternative vacuum clip.

FIG. 1 illustrates formed plastic sheet 2 prior to forming a vacuum bag in roll or bag format. Formed plastic sheet 2 begins as a flat plastic sheet comprised of one or more layers to meet the thermal sealing and permeability requirements of the particular application. Multiple oblique channels 4 may be created in formed plastic sheet 2 prior to forming a vacuum bag in roll or bag format. Formed plastic sheet 2 may be transformed into a vacuum bag in roll or bag format by first folding it along centre line 5 as further illustrated in FIG. 3.

FIG. 2 provides a section A-A view of formed plastic sheet 2 and illustrates a process for forming oblique channels 4. Oblique channels 4, in this case, are of a "V" groove shape; however, oblique channels 4 may be of any convenient shape or size to suit the application.

Oblique channels 4 may be formed by moving a flat plastic sheet between two rotating rollers – upper roller 6 and lower roller 8. In this case upper roller 6 rotates in a counter-clockwise direction and lower roller 8 simultaneously rotates in a clockwise direction to draw formed plastic sheet 2 in the direction indicated by arrow 10 while applying an appropriate pressure to both sides of formed plastic sheet 2. Protrusions 12 may extend into grooves 14 to form oblique channels 4 as formed plastic sheet 2 passes between the two rollers in a formable state. This is a continuous process that may proceed at a rapid rate to form a great length of formed plastic sheet 2 in a relatively short period of time. Note that the profiles of protrusions 12 and grooves 14 may be modified to create oblique channels 4 in a wide variety of shapes, sizes, and patterns.

FIG. 3 illustrates a formed plastic sheet 2 (reference FIG. 1), which has been folded along centre line 5 to form folded plastic sheet 20. Folded plastic sheet 20 has oblique channels 4a running upwards and to the right on a bottom surface, and also has oblique channels 4b running upwards and to the left on an upper surface, as a result of the folding process. Oblique channels 4a and 4b intersect each other in a diamond pattern as a result of the folding process. The folding process may take place immediately after

the forming rollers (reference FIG. 2) and as soon as the plastic sheet has reached a non-formable state.

FIG. 4 provides a section B-B view of a folded plastic sheet 20 when folded with oblique channels 4a and 4b on the outside surfaces. Oblique channels 4a and 4b intersect at section B-B and at a variety of other sections along the length of folded plastic sheet 20. This allows air to flow freely through oblique channels 4a and 4b along a great length of folded plastic sheet 20. Further, oblique channels 4a and 4b may be designed to stay rigid while under reasonable vacuum, thus allowing air to be drawn through a great length of folded plastic sheet 20.

FIG. 5 provides an alternative section B-B view of folded plastic sheet 20 when folded with oblique channels 4a and 4b on the inside surfaces. Oblique channels 4a and 4b, when folded in this manner, will intersect at various cross sections along the length of folded plastic sheet 20 to hold top surface 24 away from bottom surface 26, creating air channel 22a and allowing air to drawn from a substantial length of folded plastic sheet 20 as described above. Air channels 22b and 22c may be formed in a similar manner.

FIG. 6 illustrates vacuum bag in roll format 30. Folded plastic sheet 20 may be converted to vacuum bag in roll format 30 by applying continuous seal 32 along the open edge to seal top surface 24 against bottom surface 26 (reference FIG. 5). Folded edge 34 forms a seal on the other side of vacuum bag in roll format 30.

Continuous seal 32 may be applied with oblique channels 4a and 4b on the inside or the outside surfaces of vacuum bag in roll format 30. Further, continuous seal 32 may be applied immediately after the forming of folded plastic sheet 20 (reference FIG. 3) as part of a continuous manufacturing process.

Vacuum bag in roll format 30 may be used by a consumer by first cutting and then sealing one end to form a vacuum bag that is sealed on three edges. An object may be placed in the vacuum bag, and the air withdrawn to form a vacuum. Oblique channels 4a and 4b will allow air to be withdrawn from all areas of the vacuum bag, as previously described, regardless of the shape of the object contained therein. Once a sufficient vacuum has been created, a seal may be formed along the fourth edge of the bag to

maintain a vacuum within the bag after the air withdrawing mechanism has been disconnected from the bag.

FIG. 7 illustrates vacuum bag in bag format 40. Vacuum bag in roll format 30 (reference FIG. 6) may be converted to vacuum bag in bag format by first cutting vacuum bag in roll format to the required length at cut line 42. Then, end seal 44 may be applied along cut line 42. As a result, vacuum bag in roll format will have three sealed edges consisting of folded edge 34, continuous seal 32, and end seal 44.

End seal 44 may be applied with oblique channels 4a and 4b on the inside or the outside surfaces of vacuum bag in roll format 30. Further, end seal 44 may be applied immediately after forming continuous seal 32, using a helical chopper for cut line 42 and a helical sealer for end seal 44, as part of a continuous manufacturing process.

Vacuum bag in bag format 40 may be used by a consumer as supplied, or the consumer may choose to shorten vacuum bag in bag format 40 by cutting another top opening 46 at a shorter length. In either case an object may be placed into vacuum bag in bag format 40, and the air withdrawn to form a vacuum. Oblique channels 4a and 4b will allow air to be withdrawn from all areas of the vacuum bag, as previously described, regardless of the shape of the object contained therein. Once a sufficient vacuum has been created, a seal may be formed along open vacuum bag edge 46 to maintain a vacuum within the bag after the air withdrawing mechanism has been disconnected from the bag.

FIG. 8 provides a side view of hand-held vacuum storage appliance 50, which includes a top half 52 and a bottom half 54 hinged and joined together at hand-held hinge 56. Top half 52 may generally contain a control mechanism and a user interface, since it is visible to the user. Bottom half 54 may generally contain a power supply, or battery source, and a vacuum pumping system. Various other layouts and configurations are also possible.

Vacuum storage bag 41, having open vacuum bag edge 46, may contain object 58. Vacuum storage bag 41 may be a vacuum bag in bag format 40 (reference FIG. 7), or a

vacuum bag in roll format sealed at one end to from a vacuum bag as previously described (reference FIG. 6).

The user may insert open vacuum bag edge 46 into gasketed opening 60 until vacuum bag edge 46 rests against rear guidepost 62. Then the user may push down on top half 52 to compress upper gasket 64 against vacuum storage bag 41, and to simultaneously compress vacuum storage bag 41 against lower gasket 66. Offset clamp 68 will engage with offset grip 70 when there is sufficient compression within upper gasket 64 and lower gasket 66 to form a substantially air tight seal around the perimeter of vacuum storage bag 41 at an appropriate distance away from open vacuum bag edge 46. Upper gasket 64 and lower gasket 66 may be designed to seal against each other in areas where they do not contact vacuum storage bag 41.

Upper gasket 64 and / or lower gasket 66 may contain hollow areas which allow air to be drawn through all or a portion of open vacuum bag edge 46. Once a sufficient vacuum has been drawn within vacuum storage bag 41, power may be applied to heat sealing bar 72 to seal the vacuum within vacuum storage bag 41. Finally, offset clamp 68 may be released from offset grip 70 to allow for the removal of a sealed vacuum storage bag 41.

FIG. 9 provides an internal view of hand-held vacuum storage appliance 50 showing an exposed bottom half 54. Offset grip 70 may be seen at the left side of, and hinge 56 may be seen at the back of bottom half 54. In addition, second grip 82 may be seen at the right side of bottom half 54.

Lower gasket 66 surrounds bottom hollow area 80, which may further contain two or more rear guide posts 62a and 62b as well as vacuum hole 84. Vacuum hole 84 may be used to withdraw air from bottom hollow area 80 and vacuum storage bag 41 (reference FIG. 8) when one is inserted into the system.

Small vacuum bag profile 86 and large vacuum bag profile 87 are representative of two possible sizes of vacuum storage bag 41 that may be used with hand-held vacuum storage appliance 50 (reference FIG. 8). Small vacuum bag profile 86 and large vacuum bag profile 87, when properly positioned with respect to bottom half 54, simultaneously

rest against rear guide posts 62a and 62b as well as side guide post 88. Vacuum hole 84 is located behind rear guideposts 62a and 62b so that air may be more easily withdrawn from a vacuum storage bag 41 with either profile.

Heat sealing strip 90 is an "L" shaped element that extends along the bottom edge of lower gasket 66 and then extends rearward past the left side of lower gasket 66 in a continuous manner. This allows heat sealing strip 90 to provide a secure seal on vacuum bag with small bag profile 86 in a single step, or to provide a secure seal on vacuum bag with large vacuum bag profile 87 in two steps.

FIG. 10 provides further detail regarding heat sealing strip 90 and shows how it may be subdivided into at least three heat sealing subsections, first heat sealing sub-section 100a, second heat sealing sub-section 100b, and third heat sealing section 100c, such that power may be selectively applied to various subsections and combinations of subsections. For example, power may be firstly and simultaneously applied to first heating subsection 100a and second heating subsection 100b to form a continuous seal between left end point 102 and second mid-point 104b. Then, power may be simultaneously applied to first heating subsection 100b and second heating subsection 100c to form a continuous seal between first mid-point 104a and right end point 106. The end result is a continuous seal between left end point 102 and right end point 106, primarily due to the fact that power has been applied twice to the second heat sealing sub-section 100b. Various other subdividing techniques and algorithms for applying power may be used, depending on the application, providing that at least some heat sealing overlap is provided for in this manner.

A first benefit of subdividing heat sealing strip 90 and applying power in this manner is that each subsection or group of subsections will require less power than the full heat sealing strip 90. As a result, a continuous seal may be obtained along heat sealing strip 90 with a smaller source of power than would normally be required, albeit over a longer period of time. Alternatively, the level of power that would normally be available to apply to a full heat sealing strip 90 may be applied to each group of subsections, allowing them to reach a higher temperature in a shorter period of time and enabling them to complete the sealing process in a shorter period of time.

A second benefit of subdividing heat sealing strip 90 and applying power in this manner is that the unsealed portion of vacuum storage bag 41 (reference FIG. 8) may be controlled, and air may still be withdrawn through this unsealed portion of the bag. This provides the flexibility required to seal vacuum bags 41 having a width greater than gasket 66 (reference FIG. 9) in a two step process.

FIG. 11 illustrates how the above methods may be used to seal a larger vacuum storage bag 41 using a two step process. Referring to step "A", vacuum storage bag 41 may be firstly positioned in hand-held vacuum storage appliance 50 (reference FIG. 8) such that it rests against rear guideposts 62a and 62b with first edge 110 against side guidepost 88. Power may then be applied to heat sealing strip 90 (reference FIG. 9) to form first heat seal 112.

Referring to step "B-1", vacuum storage bag 41 may removed, turned over, and then re-positioned such that it rests against rear guideposts 62a and 62b, now with second edge 114 against side guide post 88. This re-positioning places first heat seal outside of and to the left of lower gasket 66. Power may then be applied to a primary portion of heat sealing strip 90 (reference FIG. 10), as described above, to form primary second heat seal 116a.

Primary second heat seal 116a may extend sufficiently to cross over first heat seal 112. Further, primary second heat seal 116a may be formed sufficiently close to lower gasket 66 such that air is substantially prevented from being drawn through vacuum storage bag 41 in the area bounded by lower gasket 66 and first heat seal 112. As a result, substantially all of the air drawn through vacuum hole 84 will be withdrawn from vacuum storage bag 41 through the remaining unsealed edge. Air will be withdrawn from all parts of vacuum storage bag 41 through oblique channels 4a and 4b as previously described.

Vacuum storage bag 41 may remain in place, with second edge 114 against side guidepost 88, until a sufficient vacuum has been drawn therein. Then, power may be applied to a secondary portion of heat sealing strip 90 (reference FIG. 10), as described above, to form a continuous second seal comprised of primary second heat seal 116a and secondary second heat seal 116b. First heat seal 112, primary second heat seal

116a, and secondary second heat seal 116b now form a continuous seal across the top of vacuum storage bag 41 to retain the vacuum formed therein.

FIG. 12 illustrates the effectiveness of an "L" shaped sealing pattern under several misalignment scenarios. First heat seal 112 may be formed at the top of vacuum storage bag 41 as described above. Second heat seal 116 may also be formed at the top of vacuum bag, to form a continuous seal across the top of vacuum storage bag 41, with normal intersection point 117, as described above.

In some cases second heat seal 116 may be misaligned relative to first heat seal 112; however, a continuous seal will still be formed across the top of vacuum bag because of the overlapping "L" shaped sealing patterns. For example top misaligned second heat seal 120, together with first heat seal 112, forms a continuous seal across the top of vacuum storage bag 41 with top intersection point 121. Alternatively, bottom misaligned second heat seal 122, together with first heat seal 112, also forms a continuous seal across the top of vacuum storage bag 41, in this case with bottom intersection point 123. It follows that first heat seal 112 and second heat seal may both be misaligned while still producing a continuous seal across the top of vacuum storage bag 41.

FIG. 13 provides a top view of hand-held vacuum storage appliance 50, showing the top of top half 52, hand-held hinge 56, offset clamp 68, and second clamp 130. Hand-held storage appliance 50 is designed to accommodate vacuum storage bags 41 having a variety of widths and formats as described above.

Vacuum storage bag 41 may be inserted into front loading area 132 with its right edge 133 against right alignment mark 134. Right alignment mark 134 may be located immediately above side guidepost 88 (reference FIG. 9). Vacuum storage bag 41 may be pushed rearwards until open edge 135 rests against rear alignment mark 136. Rear alignment mark 136 may be located directly above rear guide posts 62a and 62b (reference FIG. 9). Precise alignment is not a critical requirement, as described above.

At this point the user must observe whether or not the left side of vacuum storage bag 41 extends past left alignment mark 138. If so, then the user may execute a two step process consisting of seal only followed by vacuum seal. If the left side of vacuum

storage bag 41 does not extend past left alignment mark 138, then the user only needs to execute a single step process consisting of vacuum seal left alignment mark 138 may be located immediately above the left edge of lower gasket 66 (reference FIG. 9).

In this case left edge 137 extends past left alignment mark 138, necessitating a two step process. The first seal only step may be initiated by aligning vacuum storage bag 41 against right alignment mark 134 and rear alignment mark 136. Then top half 52 may be pushed down to engage offset clamp 68 and second clamp 130 with offset grip 70 and second grip 82, respectively (reference FIG. 9). Offset clamp 68 and offset grip 70 are intentionally offset and located behind rear alignment mark 136 to allow vacuum storage bag 41 to be aligned with rear alignment mark 136 and still extend past the left edge of upper half 52.

Once vacuum storage bag 41 has been clamped in this position, the first seal only step may be completed by pressing seal only button 140. Seal only light 142 may then be illuminated with a first colour to indicate that the sealing process is underway. The colour of seal only light 142 may be changed to a second colour after the seal only process has been complete, indicating to the user the vacuum storage bag 41 may be removed from the system. Offset clamp 68 and second clamp 130 may be manually or automatically released at this point in time. Several other control mechanisms and user interface algorithms may be used to accomplish the same end result.

The second vacuum seal step may be initiated by turning over vacuum storage bag 41 and re-inserting it into hand-held vacuum storage appliance 50 such that left edge 137 is now aligned with right alignment mark 134, and the now partially sealed open edge 153 is aligned with rear alignment mark 136. Then top half 52 may be pushed down to engage offset clamp 68 and second clamp 130 with offset grip 70 and second grip 82, respectively (reference FIG. 9).

Once vacuum storage bag 41 has been clamped in this second position, the second vacuum seal step may be completed by pressing vacuum seal button 144. Vacuum seal light 146 may then be illuminated with a first colour to indicate that the vacuum seal process is underway. The colour of vacuum seal light 146 may be changed to a second colour after the vacuum seal process has been completed, indicating to the user that

vacuum storage bag 41 may be removed from the system. Offset clamp 68 and second clamp 130 may be manually or automatically released at this point in time. Several other control mechanisms and user interface algorithms may be used to accomplish the same end result.

Should vacuum storage bag 41 not extend past left alignment mark 138, the user need only complete a single step process consisting of the vacuum seal process only. This step may be initiated by inserting the smaller format vacuum storage bag 41 into hand-held vacuum storage appliance 50 such that right edge 133 is aligned with right alignment mark 134. Then top half 52 may be pushed down to engage offset clamp 68 and second clamp 130 with offset grip 70 and second grip 82, respectively (reference FIG. 9).

Once the smaller format vacuum storage bag 41 has been clamped in this position, the single vacuum seal step may be completed by pressing vacuum seal button 144. Vacuum seal light 146 may then be illuminated with a first colour to indicate that the vacuum seal process is underway. The colour of vacuum seal light 146 may be changed to a second colour after the vacuum seal process has been completed, indicating to the user that the smaller format vacuum storage bag 41 may be removed from the system. Offset clamp 68 and second clamp 130 may be manually or automatically released at this point in time. Several other control mechanisms and user interface algorithms may be used to accomplish the same end result.

Should the user accidentally press vacuum seal button 144, as a first step, for a vacuum storage bag 41 that extends past left alignment mark 138, then a controller may be used to sense the fact that the level of vacuum within vacuum storage bag 41 is not increasing at an acceptable rate, and within an acceptable amount of time, indicating that the air is being withdrawn from an open or partially open rather than a sealed vacuum storage bag 41. The controller, upon deducing this situation, may then revert back to a seal only step and perhaps communicate this to the user by illuminating seal only light 142 in some noticeable manner, or through some other suitable means. The user may then turn over the bag, as previously described, and complete the vacuum sealing process by pressing the vacuum seal button once again.

Should vacuum storage bag 41 be supplied as vacuum bag in roll format 30 (reference FIG. 6) then seal only button 140 may be used to seal the open end of vacuum bag in roll format 30. Seal only button 140 may be used once for a vacuum bag in roll format 30 that does not extend past left alignment mark 138 when aligned with right alignment mark 134, or twice for a vacuum bag in roll format 30 that does extend past left alignment mark 138 when alignment with right alignment mark 134, providing that in the latter instance vacuum bag in roll format 30 is removed, turned over, and then re-aligned with right alignment mark 134 prior to the second use of seal only button 140, as previously described. After sealing one end in the manner, vacuum bag in roll format 30, in effect, becomes vacuum bag in bag format 40, and may be vacuum sealed as described above.

Hand-held vacuum storage appliance 50 may be held above vacuum storage bag 41 during the vacuum sealing process. This will substantially prevent any fluids contained within vacuum storage bag 41 from being drawn into vacuum storage appliance 50 with the air that is being withdrawn from vacuum storage bag 41.

Figure 14 provides a side view of front loading vacuum storage appliance 150, which includes a main body 152 and a front cover 154 hinged and joined together at front loading hinge 156. Front cover 154 may generally contain a control mechanism and a user interface, since it is visible to the user. Main body 152 may generally contain a power supply, a controller, and a vacuum pumping system. Various other layouts and configurations are also possible.

Vacuum storage bag 41, having open vacuum bag edge 46, may contain object 58. Vacuum storage bag 41 may be a vacuum bag in bag format 40 (reference FIG. 7), or a vacuum bag in roll format sealed at on end to from a vacuum bag as previously described (reference FIG. 6).

The user may insert open vacuum bag edge 46 into front loading gasketed opening 160 until open vacuum bag edge 46 rests against upper guidepost 162. At this point open vacuum bag edge 46 will be correctly positioned between front gasket 164 and rear gasket 166.

FIG. 15 provides a front view of main body 152, and illustrates the auto bag sensing and pull-in mechanisms. In this case it may be seen that when vacuum storage bag is inserted until open vacuum bag edge 46 rests against upper guideposts 162a, 162b, and 162c, open vacuum bag edge 46 will also push against and activate left vacuum bag sensing lever 168a and / or right vacuum bag sensing lever 168b. Vacuum bag sensing levers 168a and 168b are positioned across the width of main body 152 to accommodate any irregularities in open vacuum bag edge 46, and to more reliably sense the presence of vacuum storage bag 41 within the system.

At such time as vacuum bag sensing levers 168a and / or 168b are activated, a controller may automatically move pull-in pins 170a and 170b towards the rear of main body 152. Pull-in pins 170a and 170b may be releasably attached to front cover 154, which is also rotationally attached to main body 152 at front loading hinge pins 156a and 156b (reference FIG. 13). The action of moving pull-in pins 170a and 170b towards the rear of main body 152 will cause the rear face of front cover to be aligned parallel with the front face of main body 152, compressing front gasket 164 against rear gasket 166, and holding vacuum storage bag 41 in the correct position for further sealing and / or vacuum storage operations.

The force applied to pull-in pins 170a and 170b may be sufficient to hold vacuum storage bag 41 in place and form a suitable seal around the interface between front gasket 164, rear gasket 166, and vacuum storage, while being sufficiently limited as to not cause damage to a finger or other foreign object that may be accidentally inserted between front gasket 164 and rear gasket 166 (reference FIG. 13). Alternatively, a force limiting controller may sense that an object other than vacuum storage bag 41 has been inserted between front gasket 164 and rear gasket 166, and limit the applied force accordingly.

Front gasket 164 and / or rear gasket 166 may contain hollow areas which allow air to be drawn through all or a portion of open vacuum bag edge 46, which is now contained within the sealed perimeter of front gasket 164 and rear gasket 166, by withdrawing air through front loading vacuum hole 174. Once a sufficient vacuum has been drawn within vacuum storage bag 41, power may be applied to heat sealing bar 172 to seal the

vacuum within vacuum storage bag 41. Finally, pull-in pins 170a and 170b may be released to allow for the removal of a sealed vacuum storage bag 41.

FIG. 16 illustrates how pull-in pins 170a and 170b interface with front cover 154. Pull-in pin 170a, and 170b (not shown) protrude into front cover 154 to releasably interface with sliding latch 180. Pull-in pin 170a remains releasably attached to sliding latch 180 during normal operation, with sliding latch 180 between shoulder 182 and extended head 184. This configuration allows front cover 154 to be pushed or pulled by pushing or pulling pull-in pin 170a, respectively, from within main body 152. In this case, pull-in pin 170a has been fully pulled from within main body 154, compressing front gasket 164 against rear gasket 166. Pull-in pins 170a and 170b may be activated using solenoids or any other convenient means of activation.

FIG. 17a and 17b illustrate how pull-in pins 170a and 170b may be releasably attached to sliding latches 180a and 180b, respectively. In this case front cover 154 and sliding latch 180a are viewed from the front, and sliding latch 180a is in mechanical communication with release button 190a. During normal operation, as represented by FIG. 17a, retainer spring 192a may hold sliding latch 180a in a leftmost position such that pull-in pin 170a is held firmly within necked in area 194a. However sliding latch 180a may be released from pull-in pin 170a by pushing in release button 190a to free pull-in pin 170a from necked in area 194a, as represented by FIG 17b. This allows front cover to be swung outwards and upwards from main body 152 (reference FIG. 15) for cleaning and other purposes.

The pushing in of release button 194a will put retainer spring 192a under tension, causing release button 194a to return to a normal position as soon as the user removes a finger from release button 194a. Retainer spring 192a will also allow sliding latch 180 to automatically re-engage with pull-in pin 170a, upon placing front cover back in the normal position, by first allowing sliding latch 180 to slide to the right and then back to the left as necked in area 194a slides over extended head 184 (reference FIG. 15). Sliding latch 180b (not shown) may be releasably attached to pull-in pin 170b (not shown) in a similar manner, although the direction of travel of sliding latch 180b, to initiate the release, will be the reverse of sliding latch 180a.

FIG. 18 provides a side view of front loading vacuum storage appliance 150 with work platform 200 and roll feed mechanism 202 for vacuum bags in roll format 30. Vacuum bags in roll format 30 may be rotationally dispensed from roll feed mechanism 202. Vacuum bags in roll format may be inserted in between work platform 200 and main body 152, over fixed retainer bar 203, and under moving retainer bar 204 so that they may be easily accessed from the front of front loading storage appliance 150. Further, moving retainer bar 204 holds vacuum bag in bag format 30 against work platform front lip 206 so that a new length of vacuum bag in bag format 30 is automatically pulled forward when work platform 200 is pulled forward.

Work platform 200 may be pulled forward from the front of front loading vacuum storage appliance 150 by pulling bottom tab 208 down and forward until front support arm 210 slides past and is held up by locking pin 212. Locking pin 212, together with front support arm 210, forms a type of fulcrum which translates a downward force at the front extremity of work platform 200 to an upward force against the bottom of main body 152 at the rear extremity of work platform 200, creating a stable work platform 200 when in the extended position (dotted lines). Rear support arm 214 keeps work platform 200 parallel to the bottom surface of main body 152 at all times. An extended work platform retainer spring 207 may store sufficient potential energy to return work platform 200 to a retracted position when required.

FIG. 19 shows work platform 200 in the extended position. An appropriate length of vacuum bag in bag format 30 may be conveniently cut by sliding cutting blade 220 across the top surface of vacuum bag in bag format 30. Cutting blade 220 may extend down into cutting recess 222, on the top surface of work platform 200, to ensure a smooth cut across the full width of vacuum bag in bag format 30. Cutting blade 220 may be manually or automatically activated.

A cut length of vacuum bag in bag format 30 may be sealed on one end to form vacuum storage bag 41. Vacuum storage bag 41, containing object 58, may then be placed on an extended work platform 200 with open edge 46 extending upwards between front gasket 164 and rear gasket 166 until it rests against upper guide post 162. Then, front cover 152 will be automatically pulled in to start the vacuum storage and sealing process as previously described. Vacuum storage bag 41 may also be used with work platform

200 in the retracted position, particularly when object 58 is sufficiently light to be easily supported by the user throughout the vacuum sealing process.

Of particular note is the fact that open edge 46 opens upwards, and that open edge 46 is located some distance above fluid 59 that may be associated with object 58 in vacuum storage bag 41. This configuration substantially prevents the air withdrawing mechanism contained within main body 152 from inadvertently pulling in fluid 59 along with the air contained within vacuum storage bag 41.

Work platform 200 may be returned to the retracted position at any time by first depressing locking pin 212 such that front support arm 210 may swing freely downwards and rearwards. Locking pin 212 may be in mechanical or electro-mechanical communication with rear locking pin 213 to release rear support arm 214 in a similar manner. The potential energy stored in an extended work platform retainer spring 207 may supply substantially all of the power necessary to return work platform 200 to a retracted position, and to hold it there. Moving retainer bar 204 may be configured to interface with fixed retainer bar 203 such that the cut edge of vacuum bag in bag format 30 becomes retained by moving retainer bar 204 so that it will be automatically pulled out with work platform 200 upon the next extension of work platform 200.

FIG. 20 provides a front perspective view of front loading vacuum storage appliance 150 and illustrates several operational features. Front cover 154 contains digital calendar 240, seal only button 242, seal only light 244, vacuum seal button 246, vacuum seal light 248, alignment guide 250, and front cover release button 190. Also visible are work platform 200, pull tab 208, the leading (exposed) edge of vacuum bag in bag format 30, and retractable vacuum hose 252. Retractable vacuum hose 252 may be used to conveniently draw a vacuum in wine bottles, storage containers adapted with a vacuum seal, and the like, for vacuum storage purposes.

Front cover 154 remains closed against main body 152 when front loading vacuum storage appliance 150 is not in use. The user may prepare the unit for use by pressing either seal only button 242 or vacuum seal button 246, at which time the bottom edge of front cover 152 moves forward relative to main body 152, front cover 154 being rotationally attached to main body 152 at front loading hinge 156, to create front loading

gasketed opening 160 (reference FIG. 14). Thereafter, the process is automatic and does not require the user to do anything other than support the vacuum bag and position it correctly within front loading vacuum storage appliance 150.

The vacuum storage process may begin by pulling out work platform 200. This will automatically pull out a length of vacuum bag in roll format 30, which is stored at the back of front loading vacuum storage appliance 150. Vacuum bag in roll format 30 may be further pulled out and then cut at the required length with cutting blade 220 (reference FIG. 19).

The cut length of vacuum bag in roll format 30 may be sealed at one end by first pressing seal only button 242 to open front cover 154 as previously described. Seal only light 244 may be illuminated with a first colour to indicate that front loading vacuum storage appliance 150 is ready and waiting for the insertion of vacuum bag in roll format 30. Vacuum bag in roll format 30 may then be inserted into front loading gasketed opening 160 (reference FIG. 14) with its right edge against alignment guide 250. Vacuum bag in roll format 30 may then be pushed upwards until the open edge rests against upper guide posts 162a, 162b, and 162c, and activates vacuum bag sensing levers 168a and 168b (reference FIG. 15). Vacuum bag sensing levers 168a and 168b may communicate with a controller to automatically close front cover 154 against the inserted vacuum bag in roll format 30, initiate the seal only process, and illuminate seal only light 244 with a second colour during the seal only process. Once the seal only process has been completed, seal only light 244 may then be illuminated with a third colour, or otherwise communicate to the user that the process has been completed, and front cover 154 may be opened a sufficient distance to allow the sealed vacuum bag in roll format 30 to be removed.

The user may then place an object to be vacuum sealed into the sealed length of vacuum bag in roll format 30. Alternatively a user may place an object to be vacuum sealed into a pre-formed vacuum bag in bag format 40 (reference FIG. 7). For simplicity, both configurations shall henceforth be referred to as vacuum storage bag 41 (reference FIG. 11).

Vacuum storage bag 41, containing an object to be vacuum sealed, may be vacuum sealed by first pressing vacuum seal button 246 to open front cover 154 as previously described. Vacuum seal light 248 may then be illuminated with a first colour to indicate that front loading vacuum storage appliance is ready and waiting for the insertion of vacuum storage bag 41. Vacuum storage bag 41 may then be inserted into front loading gasketed opening 160 (reference FIG. 14) with its right edge against alignment guide 250. Vacuum storage bag 41 may then be pushed upwards until the open edge rests against upper guide posts 162a, 162b, and 162c, and activates vacuum bag sensing levers 168a and 168b (reference FIG. 15). Vacuum bag sensing levers 168a and 168b may communicate with a controller to automatically close front cover 154 against the inserted vacuum storage bag 41, initiate the vacuum seal process, and illuminate vacuum seal light 248 with a second colour. This will, in turn, establish an appropriate level of vacuum within vacuum storage bag 41, form a heat seal across the top edge of vacuum storage bag 41, and apply a date stamp to vacuum storage bag 41 corresponding to the date displayed on digital calendar 240. (The date stamp mechanism may be comprised of a series of small multi-segment heating elements that resemble LEDs, and may be controlled user similar logic, but produce heat rather than light.) Once the vacuum seal process has been completed, vacuum seal light 248 may be illuminated with a third colour, or otherwise communicate to the user that the process has been completed, and front cover 154 may be opened a sufficient distance to allow the vacuum packed, sealed, and date stamped vacuum storage bag 41 to be removed.

A user wishing to draw a vacuum in a bottle, canister, or other container may use retractable vacuum hose 252. This process may be started by pulling out a sufficient length of retractable vacuum hose 252 such that it may be attached to the bottle, canister or other container. Then, the user may press vacuum hose button 254 to initiate the vacuum storage process. Vacuum seal light 248 may illuminate, change colour, or otherwise communicate to the user that the vacuum seal process has been completed. Front cover 154 will remain closed throughout this process to retain a seal in this area and allow a vacuum to be drawn within the bottle, canister, or other container attached to retractable vacuum hose 252.

The elevated mounting of front loading vacuum storage appliance 150, i.e. under overhead cupboard 258, provides for a reasonable amount of space under the unit.

Vacuum storage docking station 256, mounted on the underside of front loading vacuum storage appliance 150, makes use of this space by allowing bottle 258 to be connected to front loading vacuum storage appliance 150 by simply plugging it into the bottom of front loading vacuum storage appliance 150 rather than using retractable vacuum hose 252. A sensor attached to vacuum storage docking station 256 may sense the presence of bottle 258 and communicate with a controller to initiate the vacuum storage process. Vacuum seal light 248 may illuminate, change colour, or otherwise communicate to the user that the vacuum seal process has been completed. Front cover 154 will remain closed throughout this process to retain a seal in this area and allow a vacuum to be drawn within the bottle 258, canister, or other container attached to vacuum storage docking station 256. This feature will be particularly useful for the quick vacuum storage of spice bottles designed for this purpose, wine bottles, food canisters, and the like.

FIG. 21 illustrates two stage vacuum pumping system 260 that may be used with front loading vacuum storage appliances 150 (reference FIG. 19) and a variety of other vacuum storage appliances and devices. Two stage pumping system 260 may be used to shorten the time required to establish a suitable vacuum in vacuum storage bag 41, or establish a suitable vacuum in a bottle or container attached to retractable vacuum hose 252 for vacuum storage purposes. Controller 268 may open control valve 269 at the appropriate time, prior to establishing a suitable vacuum in a bottle or container attached to retractable vacuum hose 252. Control valve 269 may remain closed at all other times.

Primary vacuum pump 262 may be a high volume vacuum pump, capable of drawing only a limited level of vacuum. Secondary vacuum pump 264 may be a low volume vacuum pump, capable of drawing a suitable vacuum for vacuum storage purposes. Primary exhaust check valve 263 and secondary exhaust check valve 265 may be affixed in the exhaust ports of primary vacuum pump 262 and secondary vacuum pump 264, respectively, to prevent the back flow of air through the exhaust ports when the individual vacuum pumps are not running.

Vacuum sensor 266 senses the level of vacuum within two stage vacuum pumping system 260, and any vacuum storage bag 41 or container attached to retractable vacuum hose 252, that may be attached to vacuum pumping system 260. Vacuum sensor 266 provides a signal to and is in communication with controller 268.

Altitude sensor 267 senses the altitude at which the system is being used, either by sensing pressure or by some other means. Alternatively, altitude sensor 267 may be sensitive to a manual adjustment that allows the user to input an altitude to the system. Alternatively, altitude sensor 267 may be incorporated as part of vacuum sensor 266 by using a combined pressure and vacuum sensor for vacuum sensor 266, and taking an altitude depending pressure reading at such time(s) as main channel 270 is not sealed and is open to the atmosphere, for example just prior to each use of the system. In either case, altitude sensor 267 is in communication with controller 268 such that controller 268 is aware of the operating conditions. Controller 268 may use the input from altitude sensor 267 to set a first threshold pressure and a second threshold pressure, corresponding to an intermediate and target set-points respectively, that is suitable for the operating conditions. As an example, a target set point of 30" Hg vacuum may be achievable at sea level but not at 5000' altitude. The controller may adjust the target set point downwards by approximately 1" Hg vacuum for each 1000' altitude to achieve the desired set-point level. Other algorithms and combinations of set points may be used to achieve similar results.

Controller 268 may first provide power to primary vacuum pump 262 and secondary vacuum pump 264 at the beginning of the vacuum storage process to maximize the speed at which air may be withdrawn through main channel 270. Controller 268 may then disconnect power from primary vacuum pump 264 when vacuum sensor 266 indicates that the vacuum within the system has reached a first threshold level, and retain power to secondary pump 264 until such time as vacuum sensor 266 indicates that the level of vacuum within the system has reached a second threshold level that corresponds to a suitable level of vacuum for vacuum storage purposes. Controller 268 may then disconnect power from secondary vacuum pump 264 to prevent any further withdrawal of air from the system.

Finally, controller 268 may indicate to the user that a suitable level of vacuum has been drawn and may then apply power to heat sealing bar 172 while supplying the correct date to and supplying power to the date stamping mechanism.

FIG. 22 illustrates an alternative means to speed up the vacuum packing process while using only secondary vacuum pump 264 and vacuum retaining chamber 280. Secondary vacuum pump 264 may be a low volume vacuum pump, capable of drawing a suitable vacuum for vacuum storage purposes, and fitted with secondary exhaust check valve 265.

Controller 268 may first open vacuum retention valve 280 and apply power to secondary vacuum pump 264 to establish a suitable food storage level of vacuum in vacuum retaining chamber 280. Vacuum retaining chamber 282 may be of any suitable shape that may fit within the confines of the vacuum storage appliance, or in fact may be defined by all or parts of the vacuum storage appliance all or some of the vacuum storage appliance components being contained within vacuum retaining chamber 280. Controller 268 may close vacuum retention valve 280 and remove power from secondary vacuum pump 264 when the system has reached an altitude adjusted second threshold level of vacuum as previously described. Secondary exhaust check valve 265 prevents the backflow of air into the system.

In this case, controller 268 may simultaneously open vacuum retention valve 280 and apply power to secondary vacuum pump 264 at the beginning of the vacuum storage process to maximize the speed at which air may be withdrawn through main channel 270. This will create an immediate and increased vacuum pumping capability, as the flow of air being absorbed by the vacuum within vacuum retaining chamber 282 will enhance the normal vacuum pumping capabilities of secondary vacuum pump 264.

Controller 268 may then close vacuum retention valve 280 when vacuum sensor 266 indicates that the vacuum within the system has reached a first threshold level, and retain power to secondary pump 264 until such time as vacuum sensor 266 indicates that the level of vacuum within main channel 270 and any vacuum storage device attached to main channel 270, has reached a second threshold level that corresponds to a suitable level of vacuum for vacuum storage purposes. At that time controller 268 may indicate to the user that a suitable level of vacuum has been drawn and may then apply power to heat sealing bar 172 while supplying the correct date to and supplying power to the date stamping mechanism. Finally controller 268 may remove power from secondary pump 268 to complete the vacuum sealing process.

At some time later, when the system is not in use and inner gasket 166 and outer gasket 164 have been re-sealed, controller 268 may once again open vacuum retention valve 280 and apply power to secondary vacuum pump 264 to establish a suitable food storage level of vacuum in vacuum retaining chamber 280, thus preparing the system for a subsequent vacuum storage operation. Vacuum retaining chamber 282 acts as a type of vacuum storage battery that speeds the rate at which air may be withdrawn from an external bag or container, and may be re-charged by secondary vacuum pump 264 between uses.

FIG. 23 illustrates a passive vacuum indicator 290 that may be used to ensure consumers that a suitable food storage vacuum exists within vacuum storage bag 41 or any other type of vacuum storage bag or container. Passive vacuum indicator 290 may have an opaque half 292 and a transparent half 293. Opaque half 292 may contain vacuum sensitive bladder 294 having flexible sides and being affixed to opaque half 292 with adhesive 296 or through some other means. Transparent half 293 may contain perforations 298 to allow the free flow of air into or out of transparent half 293, or be permeable through some other method or means.

Vacuum sensitive bladder 294, being only affixed to opaque half 292, may be free to expand into or retract out of transparent half 293. Vacuum sensitive bladder 294, containing a fixed amount of air or other gas, will expand in a vacuum since as the pressures inside and outside of vacuum sensitive bladder 294 attempt to equalize. As a result, vacuum sensitive bladder 294 will expand into transparent half 293 when passive vacuum indicator 290 is placed in a vacuum. Further, vacuum sensitive bladder 294 will extend a farther distance into transparent half 293 as the level of vacuum increases, until such time as vacuum sensitive bladder 294 hits the end of transparent half 293.

Passive vacuum indicator 290 is subject to some variability, e.g. vacuum sensitive bladder 294 may also expand as the temperature rises; however, it is reliable enough to provide a clear indication to the user that a suitable vacuum exists for food storage or marinating purposes. Some variability may be compensated for by establishing an acceptable operating range, for example by providing a minimum vacuum line 299 and sizing vacuum sensitive bladder 294 relative to transparent half 293 such that vacuum

sensitive bladder 294 will hit the end of transparent half 298 at a level of vacuum achievable at most altitudes, and then indicating to the user that the level of vacuum is acceptable if the end of the bladder is anywhere between vacuum line 299 and the end of transparent half 293. The temperature variability may be minimized by choosing an appropriate gas, for within vacuum sensitive bladder 294, that is relatively insensitive to temperature changes.

The functionality of passive vacuum indicator 290 may be enhanced by providing a bright and suitable colour for vacuum sensitive bladder 294 that may be clearly visible through transparent half 293. Further, different coloured bands may be applied to vacuum sensitive bladder 294 such that, for example, a first visible red band moves towards the end of transparent half 293, and a second visible green band becomes visible as vacuum sensitive bladder 293 expands under a vacuum. Under this configuration, the user may be confident that a suitable level of vacuum exists upon seeing the green band.

It should be realized that several different configurations are possible using the vacuum sensitive bladder technique. Others may include a button that is made to protrude upon the expansion of a vacuum sensitive bladder, or possibly just a uniquely shaped vacuum sensitive bladder with a recessed area that only becomes visible when the vacuum sensitive bladder expands under a vacuum. All of these various methods are within the spirit and intent of the invention taught herein.

FIG. 24a illustrates vacuum clip 300 in the open position. Vacuum clip 300 may be opened by gripping top indent 302 with one's forefingers, resting one's palm on vacuum clip actuator 304, and then squeezing one's hand to draw vacuum clip actuator 304 towards main body 152, an integral part of front loading vacuum storage appliance 150. This causes vacuum clip 300 to open as vacuum clip actuator 304 rotates on vacuum clip hinge seal 306, moving retaining seal bracket 308 away from main body 152 such that vacuum storage bag 41 may be inserted into vacuum clip 300, as shown. This opening action also compresses vacuum clip spring 310, which pushes against retaining protrusions 312a and 312b, in main body 152 and vacuum clip actuator 304, respectively, and remains ready to automatically close vacuum clip 300 as soon as vacuum clip actuator 304 is released. Vacuum clip actuator 304 may be held in the open

position manually, or with a retaining clip (not shown) that automatically engages when vacuum clip actuator is in the open position, or through some other means.

The operation of vacuum clip 300 is very similar to that of a standard clipboard, however the function of the former is substantially different than that of the latter. A standard clipboard is designed to hold papers and the like in place. Vacuum clip 300, on the other hand, is specifically designed to hold vacuum storage bag 41 in place and to seal the open end of vacuum storage bag 41 against the atmosphere surrounding vacuum clip 300 such that a suitable level of vacuum may be drawn within vacuum storage bag 41 for food storage purposes. Front loading vacuum storage appliance 150 may be configured with vacuum clip 300 to operate conveniently on a table or counter top, to be mounted under the overhead cupboards, or to be mounted within another cabinet. Vacuum clip 300 may be combined with other features, as previously described, in a fixed or detachable manner, to create a variety of front loading vacuum storage appliance products.

FIG. 24b illustrates vacuum clip 300 in the closed and sealed position. In this case vacuum clip actuator 304 has been released such that it moves away from main body 152. Vacuum clip actuator 304 may be released manually, or through the releasing movement of a retaining clip (not shown) that automatically responds to actuation of vacuum bag sensing mechanism 309, or through some other means. The progress of vacuum storage bag 41 towards vacuum bag sensing mechanism 309, and correct positioning of vacuum storage bag 41 within vacuum clip 300, may be easily monitored through observation window 307. Observation window 307 may be configured to be removable to allow for cleaning, maintenance, or other purposes.

The closing of vacuum clip 300 is aided by vacuum clip spring 310, which retains sufficient potential energy when vacuum clip 300 is in the fully closed position to press seal bracket 308 firmly against main body 152, thereby holding vacuum storage bag 41 securely in place within vacuum clip 300 such that the open end of vacuum storage bag 41 is sealed against the atmosphere surrounding vacuum clip 300. The space remaining around the open end of vacuum storage bag 41, within this seal, need only be sufficient to allow the free flow of air through the open end of vacuum storage bag 41. This will contribute to the performance of the underlying vacuum appliance since any excess air

remaining around the open end of vacuum storage bag 41, while in vacuum clip 300, would need to be completely removed before a sufficient level of vacuum may be achieved within vacuum storage bag 41 for food storage purposes.

The seal formed by the closing of vacuum clip 300 is comprised of a combination of active and passive components which surround the open end of vacuum storage bag 41, specifically an active vacuum clip hinge seal 306 in combination with passive flexible seals 314a and 314b in main body 152 and seal bracket 308, respectively. Flexible seals 314a and 314b may be constructed of any flexible material capable of sealing against the outer surface of vacuum storage bag 41 while allowing air to be pulled from vacuum storage bag 41 through oblique channels 4a and 4b (reference FIG. 3). Progressive heat sealing strip 316 remains ready to form a seal across the open end of vacuum storage bag 41 when and as required.

FIG. 25 provides a front view of the vacuum clip 300 components associated with main body 152, after the removal of vacuum clip actuator 304 and seal bracket 308 (reference FIG. 24a). Vacuum storage bag 41 remains in place for illustrative purposes only.

Vacuum clip hinge seal 306 forms an active seal in parallel with and above the open end of vacuum storage bag 41, i.e. it remains sealed regardless of the position of seal bracket 308 (reference FIG. 24) relative to main body 152. Vacuum clip hinge seal 306 may be inexpensively constructed from plastic, for example as a flexible and elongated thin line within a molded plastic assembly comprising all or parts of vacuum clip actuator 304, seal bracket 308, and / or main body 152 (reference FIG. 24), or through some other means. The positive seal formed by vacuum clip hinge seal 306 will improve the performance of the underlying vacuum appliance, and the mechanical barrier formed by vacuum clip hinge seal 306 will also prevent the over insertion of vacuum storage bag 41 within vacuum clip 300. Further, small protrusions on the inside surface of vacuum clip hinge seal 306 may be used to keep vacuum storage bag 41 a sufficient distance away from vacuum clip hinge seal 306 so as to allow the free flow of air through the open end of vacuum storage bag 41.

Bottom flexible seal 314a, in conjunction with top flexible seal 314b (reference FIG. 24b), forms a passive seal in parallel with and below the open end of vacuum storage bag 41,

i.e. it only forms a seal when seal bracket 308 is pressed against main body 152 with sufficient sealing pressure. Flexible seals 314a and 314b may be sufficiently wide in this area so as to form an acceptable seal across a wide range of sealing pressures. Further, flexible seals 314a and 314b may be designed with a fluid pool area 324, although the possibility of drawing fluids from vacuum storage bag 41 during the vacuum sealing process has been substantially reduced due to the front loading geometry of the vacuum packaging appliance, as previously noted. Any collection of fluids in fluid pool area 324 may be monitored through observation window 307 (reference FIG. 24a) and conveniently wiped away on an as required basis.

Flexible seals 314a and 314b may be extended upwards on both sides to mate with and seal against vacuum clip hinge seal 306, thus forming a seal around the entire open end of vacuum storage bag 41 and isolating it from the atmosphere around vacuum clip 300. It is important to note that this design will also accommodate a vacuum storage bag 41 that is wider than the sealed portion of vacuum clip 300 by allowing a portion of the wider vacuum storage bag 41 to extend beyond the sides of bottom flexible seal 314a, allowing for a multi-stage vacuum sealing process as required, for example, by hand-held vacuum storage appliance 50 (reference FIG. 9). In these cases vacuum clip 300 will only form a seal around the portion of the open end of vacuum storage bag 41 that has been inserted into the sealed area within vacuum clip 300.

Once a seal around the open end of vacuum storage bag 41 has been formed in this manner, air may be removed from the interior of vacuum storage bag 41 through vacuum header 320 which may be further connected to a vacuum pumping system through vacuum port 322. Vacuum header 320 may be of relatively small cross section with an exposed side running substantially the length of vacuum clip hinge seal 306, within the sealed area defined by vacuum clip hinge seal 306 and bottom flexible seal 314a, and above the open end of vacuum storage bag 41. The extended width of vacuum header 320 allows air to withdrawn from vacuum storage bag 41 across the width of vacuum storage bag 41. The positioning of vacuum header 320 above the open end of vacuum storage bag 41 substantially eliminates the possibility of fluids entering the vacuum pumping system since any fluids pulled from the open end of vacuum storage bag 41, although this is unlikely due to the front loading geometry as previous noted, would automatically flow along the downward sloping length of vacuum header

320, and then flow out from the lowest point of vacuum header 320 to rest on bottom flexible seal 314a, in liquid pool area 324, where they could be easily wiped away prior to a next use of the vacuum system. Further, the small cross section of vacuum header 320, relative to the much larger cross sections of vacuum chambers and other features taught in the existing art, substantially reduces the amount of air that must be removed from the sealed area during the vacuum storage process, and therefore serves to increase to performance and efficiency of the vacuum storage system.

Progressive heat sealing strip 316 may be activated in a variety of ways to form a heat seal across the top of vacuum storage bag 41, thereby retaining the vacuum that has been formed therein. Traditional vacuum sealing systems use a serial process to first form a vacuum within vacuum storage bag 41, and then create a seal to retain that vacuum. While this approach works, the time required to complete the process is unnecessarily long as it is the sum of the time required to draw the required vacuum plus the time required to form the seal. Progressive heat seal 316 may be operated in this manner; however, it's design allows the vacuum and sealing processes to be executed using a much more efficient parallel algorithm as described below.

The parallel algorithm, in conjunction with the unique design of progressive heat sealing strip 316, allows the vacuum pumping process and the heat sealing process to begin simultaneously and continue in a parallel fashion until both processes have been completed. This reduces the overall time required to complete both processes, and also allows the use of a lower capacity, slower, and less expensive vacuum pump since the heat sealing process is typically the most time consuming process. In addition, the power required to energize a segment of progressive heat sealing strip 316, as outlined below, is substantially less than the power required to energize all of heat sealing strip 316, meaning that a much smaller and therefore lower cost power supply may be used to complete the heat sealing process.

In a first parallel phase the vacuum pumping system may be turned on and first progressive heat sealing strip 316a may be simultaneously energized to form a heat seal across approximately 40% of the width of vacuum storage bag 41 as air is being withdrawn from vacuum storage bag 41. It is important to note that air may be withdrawn from the full width of the open end of vacuum storage bag 41 at the beginning of this first

parallel process, and that air may continue to be withdrawn from the approximately 60% of the width of vacuum storage bag 41 that remains open at the end of this process, i.e. after first progressive heat sealing strip 316a has completed its task and has been de-energized. In fact air may still be withdrawn from the entire inside volume of vacuum storage bag 41, despite the imposed restriction at the open end of vacuum storage bag 41, due to the arrangement of air channels within vacuum storage bag 41 as previously described.

In a second parallel phase the vacuum pumping system may be left on and second progressive heat sealing strip 316b may be simultaneously energized to form a second heat seal, connecting with the first heat seal to form a continuous heat seal across approximately 80% of the width of vacuum storage bag 41, as air continues to be withdrawn from vacuum storage bag 41. Again, air may continue to be withdrawn from the entire inside volume of vacuum storage bag 41, through the approximately 20% of the width of vacuum storage bag 41 that remains open at the end of the second parallel phase.

In a third and final parallel phase the vacuum pumping system may be left on until a suitable level of vacuum has been achieved within vacuum storage bag 41. Then third heat sealing strip 316c may be energized to form a third heat seal, connecting with the first two heat seals to form a continuous heat seal across the entire width of vacuum storage bag 41, as air continues to be withdrawn from vacuum storage bag 41. The vacuum pumping system may then be turned off to complete the vacuum sealing process and allow for the removal of vacuum storage bag 41 from vacuum clip 300.

The parallel process and progressive sealing techniques described above may be used to develop a variety of vacuum sealing algorithms using a variety of different segmentation geometries for progressive heat sealing strip 316. In applications where a range of sizes of vacuum storage bag 41 may be anticipated, an alignment mark, visible through observation window 307 or marked elsewhere on front loading vacuum storage appliance 150 (reference FIG. 24a), may be required to guide the user to position vacuum storage bag 41 such that the open end of vacuum storage bag 41 is not completely sealed until an acceptable level of vacuum has been achieved within vacuum storage bag 41. In other applications it may be more desirable to position the final phase

seal, i.e. third progressive heat sealing strip 316c or it's equivalent, closer to the middle of vacuum header 320 in order to accommodate a variety of sizes of vacuum storage bag 41 without requiring such precise alignment. In this case, the re-positioned third heat sealing strip 316c could be made clearly visible through observation window 307, using a unique colour or some other distinctive feature, and the user instructed to ensure that vacuum storage bag 41 at least covers the re-positioned third heat sealing strip 316c prior to initiating the vacuum sealing process.

FIG 26 illustrates vacuum clip 300 with active seals 340a and 340b on the left and right sides, respectively. Active seals 340a and / or 340b may be used to improve the performance of vacuum clip 300 in applications where it is known that vacuum storage bag 41 will not need to extend past one or both sides of flexible seals 314a and 314b. Vacuum clip hinge seal 306 continues to provide an active seal along the back or top of vacuum clip 300 as previously described.

In this case retaining seal bracket 308 may be extended to include seal bracket sides 342a and 342b. Seal bracket sides 342a and 342b may be configured to compress and therefore seal against the left and right sides, respectively, of bottom flexible seal 314a as they move past bottom flexible seal 314a. This compression of seal bracket sides 342a and 342b against the left and right sides of bottom flexible seal 314a creates active seals 340a and 340b, respectively, which remain sealed as vacuum clip 300 is being closed. Then, flexible seals 314a and 314b will compress against an inserted vacuum storage bag 41 (not shown) to completely seal the open end of vacuum storage bag 41 against the atmosphere around vacuum clip 300, once vacuum clip 300 is completely closed, and as previously described.

It should be noted that the geometry of active seals 340a and 340b is such that any level of vacuum within vacuum clip 300 will draw seal bracket sides 342a and 342b into tighter compression against the sides of bottom flexible seal 314a, improving the performance of active seals 340a and 340b. Further, it should be noted that this configuration precludes the requirement for top flexible seal 314b to have sides extending back to vacuum clip hinge seal 306, thus reducing the cost, complexity, and weight of top flexible seal 314b. Tripping feature 344, or some other feature, may be added to seal bracket

sides 342a and / or 342b to communicate the open or closed status of vacuum clip 300 to a control mechanism.

Active seals 340a and 340b may be deployed on one or both sides of vacuum clip 300, depending on the requirements of a specific application. For example, a device designed for the use of vacuum storage bags wider than vacuum clip 300 may be designed with right active seal 340b on the right side of vacuum clip 300 and a passive seal on the left side of vacuum clip 300, as previously described (reference FIG. 24b). In this case, vacuum storage bags wider then vacuum clip 300 may be allowed to extend past the left side of vacuum clip 300. Right active seal 340b serves a dual purpose in that it provides the necessary seal on the right side of vacuum clip 300, and it provides a convenient alignment mechanism to ensure that the right side of vacuum storage bag 41 (reference FIG. 24b) is positioned at, but does not extend beyond, the right side of vacuum clip 300.

FIG. 27 illustrates alternative vacuum clip 350, with inserted vacuum bar 352, in the open position. Similar to vacuum clip 300, alternative vacuum clip 350 may be opened by gripping top indent 302 with one's forefingers, resting one's palm on vacuum clip actuator 304, and then squeezing one's hand to draw vacuum clip actuator 304 towards main body 152, an integral part of front loading vacuum storage appliance 150. This causes alternative vacuum clip 350 to open as vacuum clip actuator 304 rotates on vacuum clip hinge 356, moving retaining seal bracket 308 away from main body 152 such that vacuum storage bag 41 may be inserted into alternative vacuum clip 350, as shown. This opening action also compresses vacuum clip spring 310 which pushes against retaining protrusions 312a and 312b, in main body 152 and vacuum clip actuator 304, respectively, and remains ready to automatically close alternative vacuum clip 350 as soon as vacuum clip actuator 304 is released. Vacuum clip actuator 304 may be held in the open position manually, or with a retaining clip (not shown) that automatically engages when vacuum clip actuator is in the open position, or through some other means.

In this case vacuum storage bag 41 is inserted into alternative vacuum clip 350 such that one side of vacuum storage bag 41 is above vacuum bar 352, and the other side of vacuum storage bag 41 is below vacuum bar 352. Vacuum storage bag 41 may be further inserted until the open end of vacuum storage bag 41 extends past flexible seal

strips 360a and 360b and also extends past locating pins 358. The further insertion of vacuum storage bag 41 may be curtailed by positioning actuator 362 which acts as a physical barrier for the top side of vacuum storage bag 41. The user may monitor the process of inserting vacuum storage bag 41 through observation window 307.

Positioning actuator 362 may be configured for multiple functions within alternative vacuum clip 350. First, positioning actuator 362 positions and retains vacuum bar 352 a suitable distance away from top flexible seal strip 360b, allowing the top side of vacuum storage bag 41 to be inserted between vacuum bar 352 and top flexible seal strip 360b. (Vacuum bar 352 will be retained against positioning actuator 362 by the potential energy within flexible spring tube connector 364, i.e. by the propensity for flexible spring tube connector 364 to remain straight. Flexible spring tube connector 364 also serves to retain vacuum bar 352 a suitable distance away from bottom flexible seal strip 360a, until such time as vacuum bar 352 is pressed against bottom flexible seal strip 360a by the closing of alternative vacuum clip 350.) Second, positioning actuator 362 serves as a physical barrier to prevent the over-insertion of vacuum storage bag 41, as previously described. Third, positioning actuator 362 may be used as a sensor to communicate the presence of vacuum storage bag 41 within alternative vacuum to a controller within front loading vacuum storage appliance 150. Positioning actuator 362 may itself be constructed of flexible material, or be allowed to move within retaining seal bracket 308, in order to allow vacuum bar 352 to be pressed against top flexible seal strip 360b, when required to do so for sealing purposes, by the closing of alternative vacuum clip 350.

Vacuum bar 352 may be in airflow communication with a vacuum pumping system through flexible spring tube connector 364, as previously described, and through vacuum adapter 366. Vacuum bar 352 may be configured with multiple vacuum holes 353 to allow for the removal of air from, and hence the creation of a vacuum within, vacuum storage bag 41.

Vacuum adapter 366 may contain integral liquid trap 368, configured to retain liquids drawn in through vacuum bar 352, although this is unlikely due to the front loading configuration of this device as previously described, while allowing the free flow of air above the liquid and through the top portion of the trap. Integral liquid trap 368 may be further configured to be conveniently accessed by the user, removed for draining and

cleaning, and replaced in a manner that retains a proper seal between integral liquid trap 368 and vacuum adapter 366. Alternative configurations may be designed with all or a portion of the liquid trapping function located within vacuum bar 352. Further alternative configurations may also allow for the complete removal of vacuum bar 352, flexible spring tube connector 364, vacuum adapter 366, and liquid trap 368 for cleaning or replacement purposes, in particular if these are designed to be disposable components.

Vacuum bar 352 may be configured with flexible sealing protrusions 355a and 355b on the top and bottom sides, respectively, adapted to press against flexible sealing strips 360a and 360b, respectively, through the bottom and top sides of vacuum storage bag 41, respectively, when alternative vacuum clip 350 is closed. Flexible sealing strips 360a and 360b extend across the open end of vacuum storage bag 41, and work in conjunction with flexible sealing protrusions 355a and 355b in this manner, to seal the open end of vacuum storage bag 41 against the atmosphere around alternative vacuum clip 350 when alternative vacuum clip 350 is in the closed position.

It is important to note that in this case that flexible sealing protrusions 355a and 355b, and flexible sealing strips 360a and 360b, must all be sufficiently flexible to interact with each other in a compression sealing manner. In the case of alternative vacuum clip 350, they may also engage in a manner that prevents rather than allows the continued flow of air through the air channels within vacuum storage bag 41 when alternative vacuum storage clip is closed. Flexible sealing ring 355, and flexible sealing strips 360a and 360b, may therefore be configured to include mechanical mating, magnetic, or other interlocking features to improve the quality of the seal across the open end of vacuum storage bag 41. Slight deformations in vacuum storage bag 41 in the area of the seal may be tolerated since they would be outside of the sealed interior of the bag once the vacuum storage process has been completed.

Locating pins 358 may be configured to pierce or otherwise positively engage with vacuum storage bag 41 upon the closing of alternative vacuum clip 350. Locating pins 358 may do so without affecting vacuum performance, since they are positioned outside of the sealed area necessary for the drawing of a vacuum within vacuum storage bag 41. Locating pins 358 may be used to hold vacuum storage bag 41 more securely in place, or as hooks upon which to "hang" vacuum storage bag 41 until alternative vacuum

clip 350 may be closed - particularly for under the cupboard or in cabinet installations where an integral work platform 200 has not been configured with the unit (reference FIG. 18).

FIG. 28 provides a top view of alternative vacuum clip 350 with vacuum bar 352. Vacuum storage bag 41 may be positioned within alternative vacuum clip 350, and alternative vacuum clip 350 may be closed, as previously described. Viewed from the top, vacuum bar 352 may be designed as a thin elongated horizontal bar that rests between the two sides of vacuum storage bag 41, and incorporates a multiplicity of small holes on the top, bottom, and all sides for the purpose of withdrawing air from within vacuum storage bag 41. The geometry of vacuum bar 352, together with the multiplicity of vacuum holes 353, allows air to be withdrawn much more effectively from vacuum storage bag 41 than would be possible with the open end of a tube, primarily because vacuum bar 352, when inserted into vacuum storage bag 41, is in airflow communication with multiple air flow channels 4a and 4b rather than the single or severely limited number of air channels 4a and 4b that might be accessible through the open end of a tube, if the tube were correctly positioned within vacuum storage bag 41.

Vacuum bar 352 may be in airflow communication with a vacuum pumping system through a slim format flat tube extending across flexible sealing strips 360a and 360b, and enshrouded with flexible sealing ring 355 to provide a compression seal in this area, as previously described.

The vacuum sealing process may be implemented using the parallel process algorithm and progressive sealing techniques, as previously described. The process may be initiated, in this case, by inserting vacuum storage bag 41 into alternative vacuum clip 350, and then closing alternative vacuum clip 350 to hold vacuum storage bag securely in place, and seal the open end of vacuum storage bag 41 against the atmosphere surrounding alternative vacuum clip 350.

In a first parallel phase the vacuum pumping system may be turned on and first alternative progressive heat sealing strip 362a may be simultaneously energized to form a heat seal across the left side of vacuum storage bag 41 as air is being withdrawn from vacuum storage bag 41. It is important to note that air may be withdrawn from the full

interior of vacuum storage bag 41 throughout this first parallel process since vacuum bar 352 is located inside vacuum storage bag 41, and due to the arrangement of air channels within vacuum storage bag 41, as previously described.

In a second parallel phase the vacuum pumping system may be left on and second alternative progressive heat sealing strip 362b may be simultaneously energized to form a second heat seal across the right side of vacuum storage bag 41. In this case second alternative heat sealing strip 362b is not continuous with first alternative heat sealing strip 362a; however, the seal formed by flexible sealing ring 355 and flexible sealing strips 360a and 360b is already continuous across the increasingly smaller open end of vacuum storage bag 41. Again, air may be withdrawn from the full interior of vacuum storage bag 41 throughout this second parallel process since vacuum bar 352 is located inside vacuum storage bag 41, and due to the arrangement of air channels within vacuum storage bag 41, as previously described

In a third and final parallel phase the vacuum pumping system may be left on until a suitable level of vacuum has been achieved within vacuum storage bag 41. Then, the "U" shaped third heat sealing strip 362c may be energized to form a third and final heat seal, connecting with the first two heat seals to form a continuous heat seal across the entire width of vacuum storage bag 41, as air continues to be withdrawn from vacuum storage bag 41. The vacuum pumping system may then be turned off to complete the vacuum sealing process and allow for the removal of vacuum storage bag 41 from alternative vacuum clip 300. The slim vertical profile of vacuum bar 352 allows for the easy removal of vacuum storage bag 41 from alternative vacuum clip 350 since vacuum bar 352 will conveniently slip back out through the remaining open portion of vacuum storage bag 41.

The simplicity of alternative vacuum clip 350 may allow it to be used in a stand-alone manner, connected to a vacuum pumping system and suitable power supply through a composite cable that includes both air flow and power flow channels. Further, alternative vacuum clip 350 may be configured to be completely portable with an integral vacuum pumping system and a rechargeable power supply. In either case the operation of a stand-alone alternative vacuum clip 350 would be similar to that of a standard "chip clip" (used to clamp the end of chip bags and the like) except that stand-alone alternative

vacuum clip 350 may be adapted to draw a level of vacuum suitable for food storage purposes, and to form the necessary seal to retain that level of vacuum, as previously described.

The vacuum packaging system and related components of the present invention allow for many applications, and may be implemented in various applications. Although reference is made to the embodiments listed above, it should be understood that these are only by way of example and to identify the preferred use of the system and components known to the inventors at this time. It is believed that the vacuum packaging system and related components of the present invention have many additional uses and implementations which will become obvious once one is familiar with the fundamental principles of the invention.